it may be supposed that the laws of disturbance are not found by me, and are not to be found by the method which I have employed. This would be a great mistake; one which I am bound to correct.

The method which Prof. Stewart recommends has had objections proposed to it by the Astronomer Royal, the Provost of Trinity College, Dublin, and by myself. It is, I think, to defend the method against these objections that Prof. Stewart has written his remarks on the modes of discussion; but I have never heard any objections to the other method, nor, as far as I can understand, does he offer any.

As the method followed by Dr. Lloyd on the Dublin Observations and by myself on the Makerstoun and Trevandrum Observations has shown every law of magnetic disturbance that has been obtained by the other, I am afraid I cannot see that the illustration of the cyclones is applicable to the two methods, even if we were bound to study large cyclones only and to put those of less than a given magnitude out of consideration.

4, Abercorn Place, London, N.W. JOHN ALLAN BROUN

## Anomalous Behaviour of Selenium

IT has been lately observed that the electrical resistance of selenium is greater in the light than in the dark. It was at first thought possible that this increase of resistance might be due to heat admitted with the light, but Prof. W. G. Adams, in his paper read before the Royal Society, June 17th, 1875, has shown that this is not the case, but that the phenomenon is a purely optical one.

The writer of this letter has to-day tried an experiment with a selenium bar belonging to the Cavendish Laboratory. Its length is 50 mm., breadth 8 mm., thickness about 1 mm.; platinum wires are soldered to its ends, and it has a hard metallic surface. Its electrical resistance is enormous. In the dark it is just over 100 megohms (100,000,000 B.A.U.) When, however, the light of the paraffin lamp of the galvanometer was allowed to fall on it from the distance of about a foot, the resistance DECREASED between 20 and 30 per cent. The experiment was repeated many times, with current sent sometimes one way, sometimes another, and with different sides and edges of the bar turned to the light, but always with the same result, namely, that the effect of letting in the light was to largely *decrease* the resistance.

A second set of experiments were made with a selenium medal struck by Berzelius soon after the discovery of the metal in 1818, and presented by him to Mr. Deck, by whose son, Mr. Deck of Cambridge, it was kindly lent for the experiment. This medal was of oval shape, about 40 millims. long by 30 broad. Owing to the difference of form between the two specimens, their specific resistances could not be accurately compared; that of the medal was, however, not more than about $\frac{1}{10}$ of that of the bar. The medal was exactly like black lead both to touch and sight, and quite different in appearance to the bar. The resistance of the medal *was sensibly the same, both in the dark and in the light; no difference could be detected.*

These experiments seem to show that the physical form of the metal has a great deal to do with its behaviour when carrying an electric current and exposed to light.

J. E. H. GORDON

Cavendish Laboratory, Cambridge, June 29

## The House-fly

As no one more competent than myself seems disposed to reply to the query of "Harrovian" (NATURE, vol. xii. p. 126) respecting a disease of the house-fly, and which is again referred to by the Rev. D. Edwardes in last week's NATURE, I may perhaps be permitted to make a few remarks thereon.

I have frequently noticed dead and dying flies thus affected, generally in the late summer and autumn; and I think I am right in attributing the phenomenon to the growth of a parasitic fungus, called, I believe, *Empusa musci*, in the fly's body. The insects may often be seen settled in a natural position on window-panes, but with the abdomen much distended, and surrounded by a collection of whitish powder, extending for a few lines in all directions on the surface of the glass. The whole of the interior organs of the abdomen are consumed by the plant, nothing remaining but the chitinous envelope, on which the mycelia of the fungi form a felt-like layer; the fructification showing itself externally as filaments protruding from between the rings of the body.

Insects are very subject to the attacks of such parasites. Some of those living in the interior organs of the body seem to do little if any injury to their "hosts," while others completely destroy them; as in the case of *Sphæria*, which changes the caterpillars at whose expense it lives into a mass of fungoid growth of most grotesque appearance. It is now well ascertained that a species of *Botrytus* produces the dreaded "Muscardine" of the silk-growers; and every practical lepidopterist has had to lament the destruction of pet broods of larvæ by some similar disease, which, though perhaps sometimes pathological, is probably in the first instance set on foot by fungi.

The whole subject of the parasites of insects is extremely interesting. According to my experience it is the exception for an insect to be quite exempt from the attacks of one or more animal or vegetable entozoic or epizoic organism; and I have often found five or six different species inhabiting one unfortunate individual.

I may mention that "Harrovian" will find some remarks on this fly-fungus by Dr. Cohn, in an early volume of the *Journ. Micros. Science.* I regret that, writing away from home, I cannot give the exact reference. W. COLE

Stoke Newington, N., July 2

[We print this letter from among several which all correctly explain the phenomenon under consideration in a similar manner.—ED.]

## Theories of Cyclones

IN NATURE, vol. xii, p. 98, you notice a paper by Dr. Hann on two rival theories of cyclones. According to one, "whirlwinds are formed mechanically by different streams of air meeting, and centrifugal force causes the central depression. The more modern theory regards a local depression as the first condition, causing an indraft resulting in a whirlwind through the earth's rotation: the primary depression is held to follow condensation of vapour."

The question is how the cyclone begins: whether the first depression is due to the centrifugal force of an eddy, or to the expansion of air in the upper strata from the heat liberated in the condensation of vapour. There need not be any controversy as to the dynamics of the cyclone after it is formed.

There is a mass of geographical evidence in favour of the first-named theory, namely, that cyclones originate in the conflict of the trade-winds of the northern and southern hemispheres when either trade-wind is drawn to some distance across the equator. (A cyclone cannot be formed on the equator, because there the earth has no rotation in relation to a vertical axis). On this subject see Mr. Meldrum's paper in NATURE, vol. ii. p. 151, and my letter in NATURE, vol. iv. p. 305; also Mr. Maury's paper in NATURE, vol. viii. pp. 124, 147, 164.

Mr. Maury fully recognises the truth that the motive power of the cyclone, once it is formed, consists in the heat liberated by the condensation of vapour, which causes expansion in the upper strata and produces an ascending current. I believe the nature of these actions was first explained by Espy, whose "Philosophy of Storms," though well known by name, seems to be less appreciated than it deserves.

There is, however, another reason for the existence of an ascending current at the centre of a whirlwind, which I do not think I have seen stated. The lowest atmospheric stratum of a whirlwind is retarded in its motion by friction against the earth, and its centrifugal force is thereby lessened in proportion to that of the upper strata. The effect of this relative deficiency of centrifugal force in the lowest stratum—that is to say, at the surface of the earth—must be to cause a flow of air at the surface of the earth towards the centre of the whirlwind, and an ascending current at its centre. Such an ascending current is probably the cause of the vertical columns of dust that accompany those small whirlwinds which are common in windy weather.

Old Forge, Dunmurry, JOSEPH JOHN MURPHY

Co. Antrim, June 23

## The Dark Argus Butterfly

IT is stated in H. N. Humphrey's work on "British Butterflies," that the Dark Argus Butterfly appears in July, and has only been found in the neighbourhood of Durham and Newcastle, and seldom above half a mile from the sea. When in May I was at Ashmore, which is on the borders of Dorset and Wilts, I took some butterflies answering exactly to the description of

the Dark Argus in Mr. Humphrey's book ; so would you kindly inform me whether this is a new locality, and whether there are two broods, the first in May and the second in July, as is the case with several of family, as would appear from the above statements? I identify the species with his Dark Argus by the following peculiarities, viz. : (1) an obscure black spot near centre of fore-wings ; (2) *no* black spots in the orange ocelli in fore-wings, the hind-wings containing these black spots as in the Brown Argus. JOHN HODGKIN, JUN.

West Derby, near Liverpool

### Meteorological Phenomenon

WHILE walking out yesterday afternoon my attention was drawn to a very remarkable display of mares-tail clouds spreading from the north, stretching in broad and narrow bands in every direction over the whole sky, and reaching beyond the zenith. While standing thus facing the sun, I saw, at a great elevation, a coloured bow with its convex red side towards the sun ; it was only about one-sixth or one-seventh of a circle, and its width seemed to be only about half that of an average ordinary rainbow. It had the appearance of being nearly horizontal, with its centre not far from the zenith, but probably not so distant. Not being accustomed to estimate elevations, when I got home I took a quadrant and held it about the elevation of the part of the bow nearest the sun, and found it came out, on repeated trials, at a *zenith distance* of 25° or 26°.* When I first saw the bow it was just 6h. 30m. P.M. Greenwich time, and the sun appeared to be about 15° above the horizon (that you can correct by calculation). The sun was shining brightly, and the bow was projected over a patch of sky slightly dimmed, at a great height (but below the cirri?), by a smoke-grey haze ; its ends just projected over the edges of the clouds. It lasted about 2m. and then faded away. There was no halo or ring but this. The wind was a rather fresh breeze, between S.S.E. and S.

Norwich, June 28 HENRY NORTON

## *OUR ASTRONOMICAL COLUMN*

SÛFI'S DESCRIPTION OF THE FIXED STARS.—The author of the ancient Uranometria to which we adverted last week, Abd-al-Rahman al-Sûfi (an abbreviation of a much longer name), was born in 903 ; he was of the sect of the Sûfis, and of Rai, a place to the east of Teheran. He was in high favour with Adhad al-Davlat, of the reigning family of Persia, and it was principally for the instruction of this prince that he wrote the work under notice, which was not the only one he produced. Ibn Jounis reports that he was not only an observer, but framed astronomical tables; and Dr. Schjellerup states he is known to have undertaken geodetic operations. He is said to have determined the length of the year, and in his tables fixes the mean motion of the sun in the Persian year at 359° 45′ 40″·2. He died in May 986. The prince Adhad al-Davlat, who gave great encouragement to the study of the sciences, commenced his reign in 949, and at the time of his death, in 983, governed the extent of country situate between the Caspian and the Persian Gulf.

The translation of the "Description of the Fixed Stars" by Sûfi was made by Dr. Schjellerup from a manuscript preserved in the Royal Library at Copenhagen, which came into the possession of Niebuhr in 1763. It is a copy made in 1601 from a manuscript transcribed in 1013, and, as stated by Schjellerup, "directement d'après l'exemplaire de Sûfi." The translation was finished when the Danish astronomer, through Herr Dorn, had the opportunity of consulting another copy of Sûfi's work, recently acquired by the Imperial Library of St. Petersburg. Where differences exist between the two authorities, they are particularised in notes to Schjellerup's translation.

The description of the stars by Sûfi, though founded upon that of Ptolemy, is not merely a simple translation. All the stars contained in Ptolemy's catalogue were sought in the positions there recorded, and submitted to attentive examination, and their magnitudes carefully noted, as is distinctly stated by Sûfi in his preface. Schjellerup draws attention to the great extent of his work, the perseverance displayed, and the minute accuracy and scientific criticism with which the whole is executed ; so that, under all circumstances, the Persian astronomer has presented us with the state of the sidereal heavens in his time, which merits the highest confidence, and which during nine centuries remains without a rival, not having found its equal till the appearance of the "Uranometria Nova" of Argelander.

Prefixed to the description of the constellations, Schjellerup has published what he terms "Tableau synoptique de l'intensité lumineuse des étoiles principales selon Ptolémée (ou Hipparch), Sûfi et Argelander," which is obviously a valuable compilation, and one that may be frequently consulted in cases where the naked-eye stars are suspected of variability. The magnitudes attributed to Ptolemy are not those given in our editions of the "Almagest," but are taken from the work of Sûfi ; indeed, Schjellerup considers the former "parfaitement inutiles," being expressed in round numbers and with much confusion, so that in this respect also we have an important addition to our knowledge of the magnitudes of the stars.

In Sûfi's tables of positions, the longitudes of the Almagest are increased 12° 42′, the latitudes being unaltered.

Generally speaking, there is a fair agreement between the magnitudes of Ptolemy and Argelander, the differences not often exceeding a degree of the scale. Amongst the larger discordances Schjellerup points to the cases of 25 Orionis and $\rho$ Eridani, estimated by Ptolemy of the third and fourth magnitudes respectively, while by Argelander they are called a bright fifth and a sixth. Sûfi's estimates in the middle of the tenth century are intermediate, the first star being rated a fourth and the second a fifth magnitude. The case of Sirius is worthy of attention for another reason. Cicero, Horace, and other classical writers refer to the ruddy colour of this star. In the editions of Ptolemy it is indicated as *ὑπόκιρρος*, but Sûfi makes no mention of this reddish tinge, though, as was stated last week, other stars well marked as red stars in our own day, are also so distinguished in his description of the heavens. Instead of reading with Halma *καὶ ὑπόκιρρος*, Schjellerup thinks we should more correctly read *καὶ σείριος*, conformable to the designations which Ptolemy gives to the other bright stars which bear a proper name, as with $\alpha$ Bootis (*ἀρκτοῦρος*), $\alpha$ Leonis (*βασιλίσκος*), &c. ; and remarks that it is certain Cicero was the first who mentions the ruddiness of Sirius, that Horace followed him, and that after Seneca we find no reference to it. Eratosthenes, Aratus, Manilius, Hyginus, and Germanicus are silent as to this particularity of the star.

The great nebula in Andromeda is named by Sûfi as an object generally known in the heavens, and it is interesting to note that he also records the variable star recently detected by Herr Julius Schmidt near $\alpha$ Virginis. Its position is very clearly described.

The title of Schjellerup's translation is "Description des Étoiles Fixes, composée au milieu du dixième siècle de notre ère, par l'Astronome Persan Abd-al-Rahman al-Sûfi, par H. C. F. C. Schjellerup, St. Petersbourg, 1874." It was presented to the Imperial Academy in June 1870.

## *SOLAR RADIATION AND SUN-SPOTS*

SINCE I communicated to NATURE the first results (vol. xii. p. 147) of an examination of the Indian registers of solar-radiation temperatures, I have examined some other registers, all of which confirm the conclusion adumbrated in my former note. Among these the most interesting and striking is the hill station Darjiling, in Sikkim, nearly 7,000 feet above the sea. The place is very cloudy, being on the outer Himalayan range, and much

* Subtended at my eye by bow and sun = about 50°?